

the Atom

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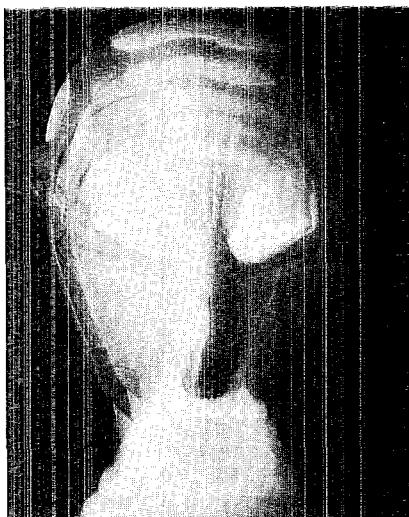
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ON THE COVER:

This respirator, mounted on a head dummy, is part of the collection at the Health Research Division's respirator laboratory. LeRoy N. Sanchez made a multiple exposure using a telephoto lens. The story, with more photos, begins on page 2.

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*Evolution of
respirator tests*



Preview:

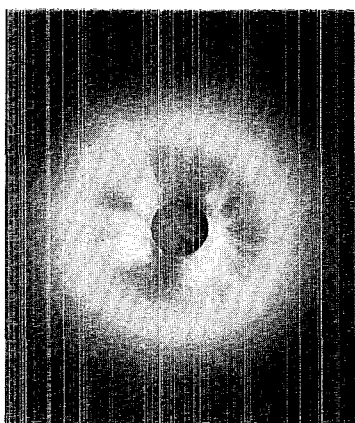
Picture yourself a fireman who soaked his beard in water, then inserted it in his mouth as a primitive attempt at respiration safety. Times have changed with the advent of filtration and air supply systems, and at LASL one research section has become a test center for respirators from many quarters. The cover photo is a rendition of one respirator type; Carolann Rodriguez' story on our research begins on page 2...



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*Radionuclide
migration
in Nevada*

What good is a 13-year-old atomic weapons test location? To some at Los Alamos, the Cambrian blast at the Nevada Test Site is of new interest as they track the migration through water and soil of radionuclides from the atomic cavity underground. After millions of gallons of water have been pumped from the Cambrian site, the water shows traces of tritium but is not seriously contaminated....

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*Tracking the
1979 eclipse*



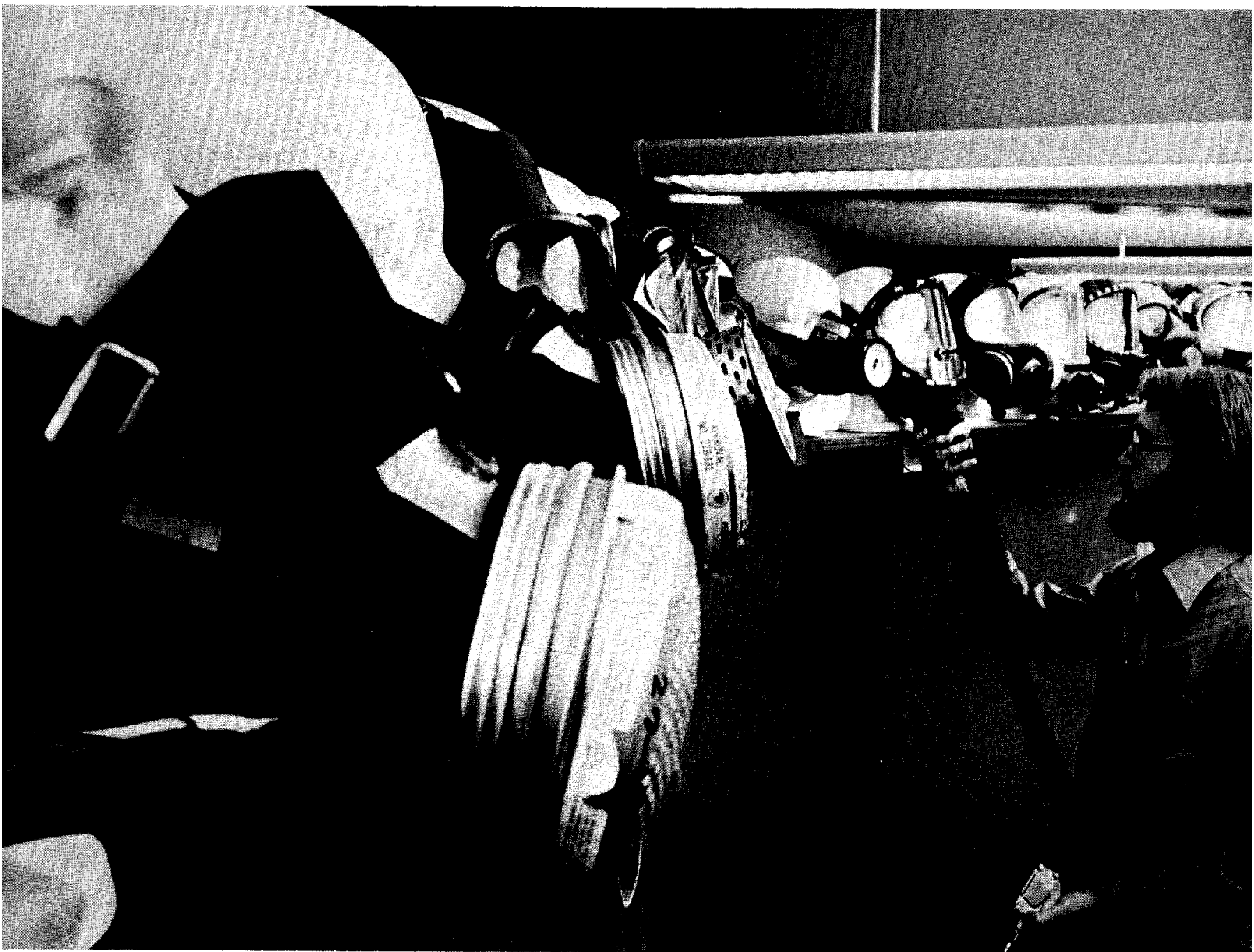
Eclipses are exciting times for scientists who study solar power and emissions. A near-total eclipse of the sun occurred over northern North America February 26, and an Air Force plane carried LASL researchers along its path. The next solar eclipse will occur in 1980 in the Indian Ocean area, but we will not see one until A.D. 2017. Laboratory photos, and a story by John Armistead, follow inside....

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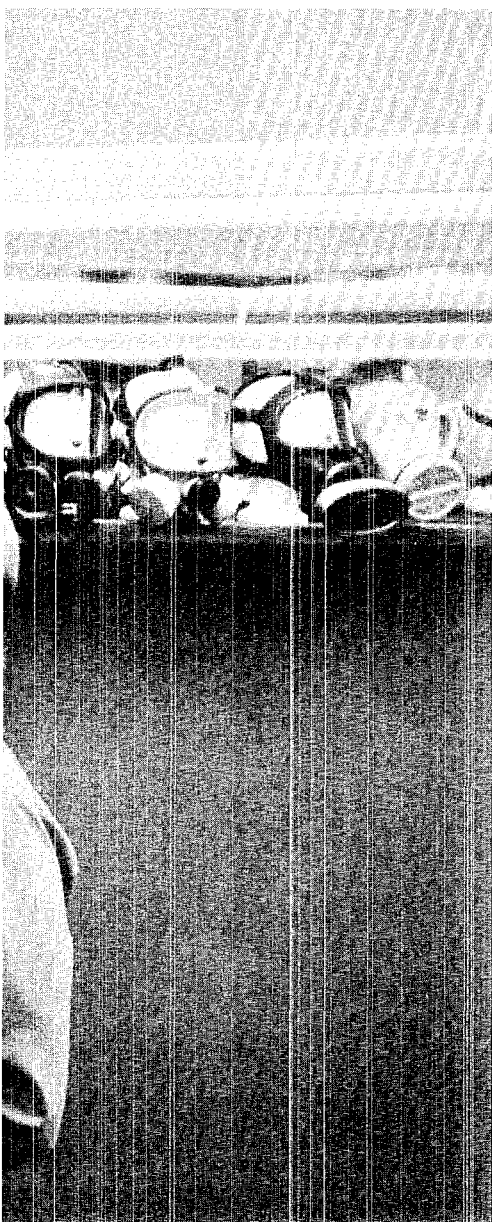
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*Ten
years ago*



Many inhalation devices have been tested for effectiveness at LASL. Here, Tom Davis, acting section leader for respiration in the Industrial Hygiene Group, checks one model that has a full facial mask. Specimens collected over the years range from early models of rubber and canvas to modern designs of space age materials.

Respirator have evolved Roman, Renaissance

Photos by LeRoy N. Sanchez



tests
from
times

In the past, people have used animal bladders, wet cloths, smoke filters, and their own beards as respirators. Today, a variety of sophisticated models from around the world are checked at the LASL test center.

By Carolann Rodriguez

Respirators, those devices that help people breathe under difficult conditions, have been a subject of study since the heyday of the Romans.

In the first century A.D., historian Pliny's writings mentioned the use of a loose-fitting animal bladder used as protection in the mining of red oxide of lead.

In Renaissance times, Leonardo DaVinci, among others, experimented with several types of breathing aids. He even recommended a wet cloth as protection against chemical warfare agents.

Much later, John Roberts in 1825 worked on a "smoke filter," expanding a subject of interest mostly to miners to include firefighters.

It took a while before this early 19th century interest was seriously explored. Even as late as 1910, the only protection some firemen had were their own beards, which were soaked in water then folded into the mouth to act as a smoke filter.

DaVinci's imaginings of chemical warfare became realities with World War I and mustard gas. Research into breathing apparatus began in earnest with scientists on both sides of the Atlantic Ocean experimenting with new forms of respirators.

New devices, new tests

Aside from the necessity of invention, researchers developed as an adjunct increasingly more sophisticated types of testing for the devices they were building.

Drawing upon these changing technologies, a group of researchers at LASL have pooled knowledge from various sources to become a

major test center for respirators from all over the world.

Using equipment and tests of their own design, members of the Industrial Hygiene Group's Respiratory Research Section (in H-5) have compiled data on the equipment, ranging from how well the masks fit various types of faces to how effectively they protect lungs from breathing foreign matter.

In addition, the section acts as consultant to the Department of Energy, the Nuclear Regulatory Commission, and DOE contractors. Armed with their data and expertise, section members are involved in an intensive technology transfer program, reaching out to private business in an effort to spread the knowledge they have collected.

The respirator section's labs in the Pajarito School building are literally lined to the rafters with respirator equipment that has passed through the inspection and testing process. The changes over the years, as breathing equipment evolved from wet beards to sophisticated devices of space-age fiberglass composites, are obvious as one views the rows and rows of collected specimens.

Much of the progress with modern respirators is a result of more sophisticated testing techniques. Before World War I, when American respirators were used mainly in mining, effectiveness tests consisted of flinging a handful of dust into the air and measuring how much got into the respirator filter while it was being used.

With mustard gas, the need for more protective respirators became urgent and so did the need for better testing methods.

World War II brought even higher protection needs. After the development of nuclear weapons, the new devices and tests devised by American researchers were frequently aimed at protection from radionuclides.

Other nations made separate progress in the testing and manufacture of devices to help men breathe under adverse conditions. In particular, Canada and England led the way in better testing methods.

Changing Sophistication

Tom Davis, LASL's acting respirator section leader, described the difference between old and new test methods as being the level of sophistication of the challenge atmosphere and the detectors.

Challenge atmospheres are the mixtures of air and test agents used to examine the effectiveness of the respirators. Early challenge atmospheres were simple, being merely rock dust or lead fumes. Today's challenge atmospheres are precisely generated sub-micron particles of oils or salts.

The other important half of testing is the detectors, the chemicals and techniques used to measure how well a given respirator is able to screen out the toxic contaminant in the challenge atmosphere.

Early techniques combining the two elements for a test were crude. Sometimes a bag of dust would be emptied in front of a blowing fan while a respirator-clad experimenter would breathe nearby.

"Tests like these weren't terribly reproducible," said Davis. A major improvement was having a defined challenge for the respirator. With this factor known and stabilized, a high-efficiency filter, one that would remove particles much smaller than pollen, would be used to protect the test subject from the challenge atmosphere.

Following the test, the filter would be removed and weighed to check how much of the challenge atmosphere it collected.

The problem with this method of testing, Davis said, was it could never be dependably accurate. "You had to handle the filter while taking it out of the holder," he said. "Considering the small quantities we would be dealing with, it was likely some matter could be dislodged."

Indeed, the quantities were so small, that analytical chemistry was used for the final measurements.

The routine of such painstaking measurements slowed down the progress of testing. "It was a chore to reproduce that type of test situation," said Davis.

Before World War I, tests consisted of flinging a handful of dust into the air, and measuring how much got into the respirator filter while it was being used.

Aerosol tests

More recently developed challenge atmospheres include the aerosol type used extensively in LASL testing.

Aerosol physicists at LASL and elsewhere developed standard techniques for making aerosols of different types. Their work allowed them to standardize the size of sub-micron particles and their relative concentration in the air.

H-5 borrowed their technology, seeing as a great aid the ability to know exactly what the challenge atmospheres were in terms of size and concentration. Using data gathered from researchers overseas, Ed Hyatt, formerly with H-5 and now retired, tested sodium chloride for use in the

aerosol-challenge atmosphere. On our side of the ocean, American studies had shown dioctyl phthalate (DOP), a very viscous fluid, to also be an effective aerosol challenge atmosphere.

Once the challenge atmosphere—essentially the testing ground of respirators—was determined, it was left to decide how to measure or detect how much of it got into the respirator.

Based on studies in aerosol research and analytical chemistry, two techniques of detection were selected.

When DOP was used as the challenge atmosphere, a light-scattering technique was used as the detector. In this method, a sample of air is taken from inside the respirator mask. This sample passes through a small chamber with a light source. The light bounces off any particles in the sample of air.

By measuring the amount of scattered light, researchers can gauge how many particles were inside the respirator. Their final findings are based on the ratio of particle concentration outside challenge atmosphere to what was able to pass to the inside of the respirator.

The second type of detector used most extensively in respirator testing is the sodium flame photometer method. In this technique, sodium chloride and water are mixed to form the aerosol for the challenge atmosphere. As in the light-scattering technique for DOP, an air sample is drawn from the inside of the respirator. This sample, containing some sodium chloride particles, is injected into a flame.

Sodium chloride particles will burn with an orange flame. By measuring the brightness of the orange flame, H-5 is able to determine the mass of particles within the respirators. Again, the ratio of what was outside to what got inside tells researchers how effective the respirator was in protecting the test subject from the challenge atmosphere.

A large chamber was constructed by LASL and is used for much of the data gathering. It is equipped with monitors and an intercom; measured particles are fed through the airflow system.

Special chamber

Much of the data gathered is generated through the use of a large volume chamber constructed by H-5 specifically for its tests. The chamber, constructed of metals, glass and plastics, measures 16 cubic meters and is equipped with monitoring equipment and an intercom.



Relaying instructions via intercom, Andy Trujillo (at right) tells Isabel Garcia (behind glass) to frown; the test will show how well the respirator she is wearing will maintain its seal during facial movements. The chamber used for testing measures 16 cubic meters and was designed and constructed by LASL personnel.

Outside the chamber, equipment disperses the aerosol. DOP and air are combined to make particles. Compressed air bubbles flow through the DOP and produce a broad range of different sized droplets. A similar process is used for sodium chloride salt.

Once the droplets are formed, inertial impacters take the larger-sized ones out. The impacters work by directing the aerosol particles at high speed against a flat plate. The air stream makes a right angle turn. Small particles can make that turn and stay in the air stream while larger particles hit the plate and are retained.

The particles remaining in the air stream are now all within the same sub-micron size range. These are fed into a large pipe connected to the air flow intake from the room surrounding the chamber.

The combined air flow is channeled through a funnel and screen before entering the chamber area. A large fan placed in the chamber keeps the air flowing through the chamber and helps disperse the challenge atmosphere more evenly.

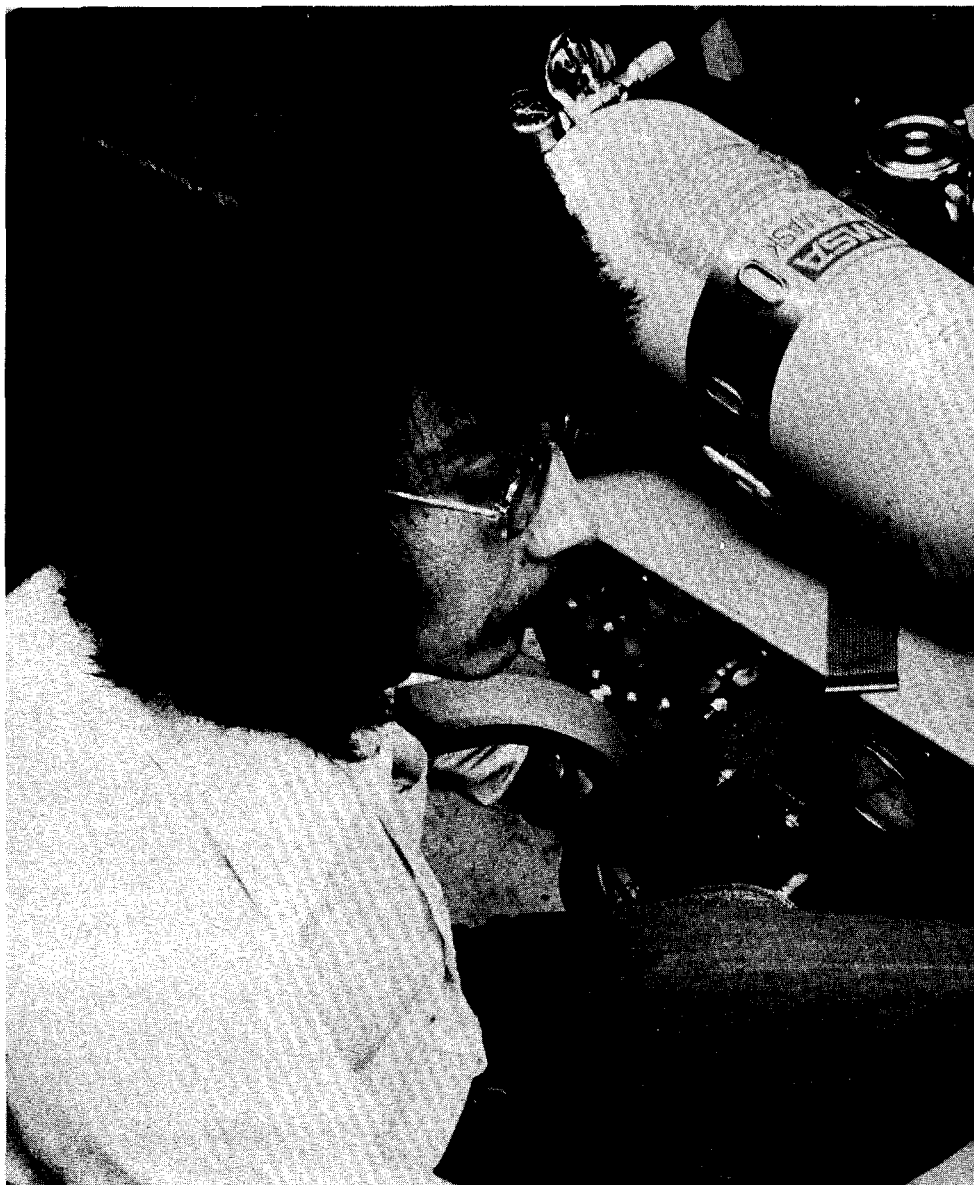
A test subject wearing the respirator to be analyzed enters the chamber. The respirator mask is fitted with two probes, one to sample the aerosol penetration into the mask, the second to provide a continuous reading of pressure inside the face piece.

The data H-5 has compiled details protection factors of various types of respirators, including self-contained breathing apparatus and air-purifying (dust) respirators.

25 in test panel

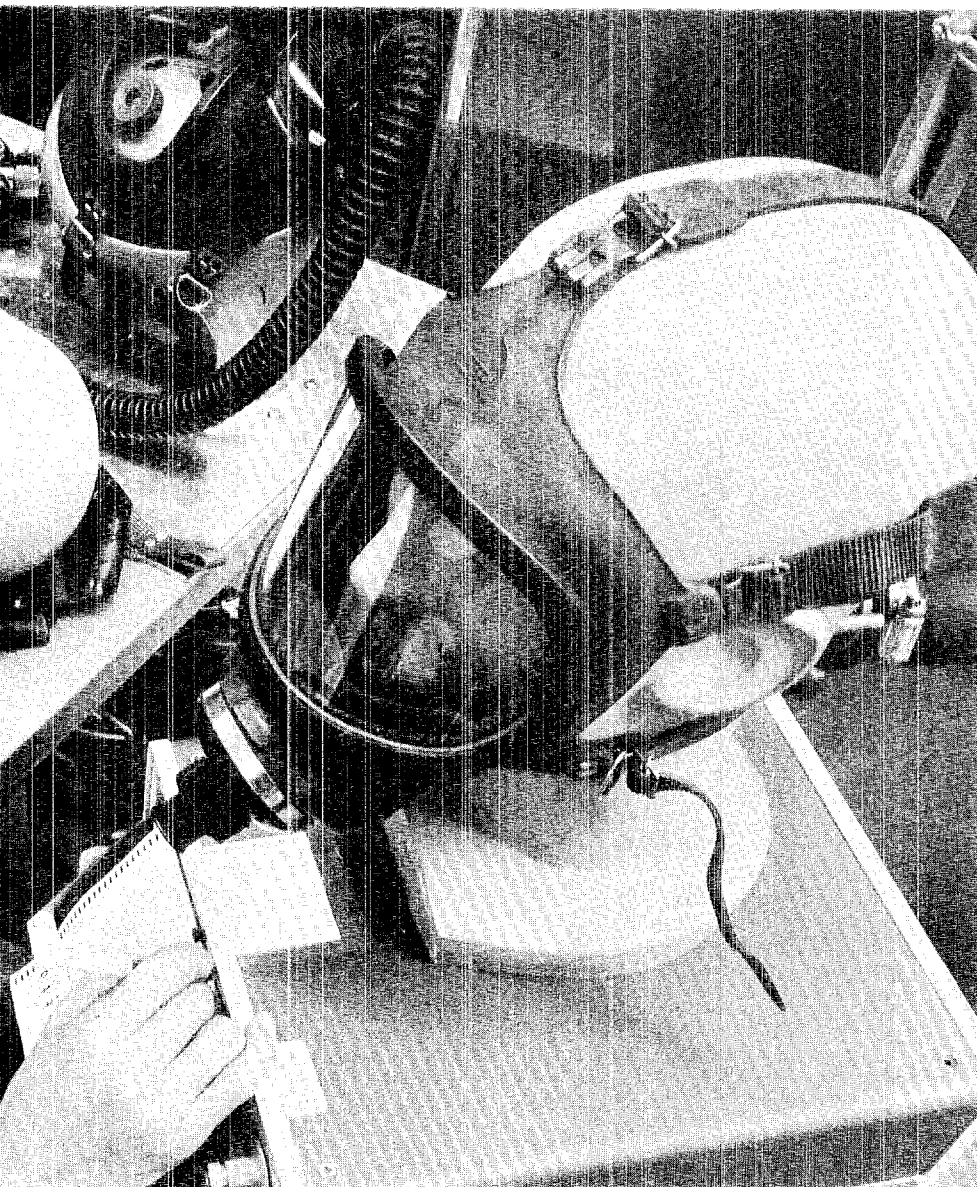
In addition to devising the tests and equipment to carry out studies, the respirator section developed an anthropometric test panel.

This test panel was composed of 25 persons, both male and female, selected according to face length and face width variations. By using this relatively broad range of facial characteristics, researchers could



A test bench is used by H-5 to measure inhalation and exhalation flows, as does the test chamber. Here, a head form, a sample probe, and an airflow port help Andy Trujillo gather data on resistance as he calibrates instruments.

Today's challenge atmospheres used for testing are mixtures of air and oils or salts. Detectors incorporate either a light-scattering technique, or rely on the sodium flame photometer method.



Persons were selected for a test panel according to their facial characteristics. Respirators were analyzed for fitting, durability, and comfort; tests simulated actual working conditions.

also study how tightly the respirators masks could seal, an important factor in protection.

Respirators were checked out for ease of donning, durability of materials, and comfort.

In the first phase of testing, the Respirator Section had test subjects go through a routine of exercises. Movements included normal and deep breathing, turning the head side to side, moving the head up and down, talking, smiling, frowning, and again, normal breathing.

While test subjects were doing this, the probes attached to the masks were taking in data on air flow and pressure.

Later tests included the subjects moving objects from high to low shelves and vice-versa, to more closely simulate actual working conditions under which the respirators might be used.

Plans for future tests include having subjects go through strenuous exercises.

New use for an old explosion cavity



The original blast site, Cambric, was undisturbed for years before it was re-drilled as part of the study. Water containing pumped radionuclides is temporarily stored in the large tanks; clean water is run free.

Since 1974, researchers have been trying to find out how radioactive elements migrate through the water table.

By Jeff Pederson

Frenchman Flat, Nevada Test Site, 1965: A small nuclear test, code-named Cambric, is fired underground with a yield of three-quarters of a kiloton. The explosion is at a depth of 294 meters, 74 meters below the water table.

After samples of debris from the blast have been collected for radiochemical analyses, Cambric is forgotten. Years pass without any significant activity taking place in this area of Frenchman Flat.

But there is now new life in Cambric, experimentally speaking, with the birth of a special project launched in 1974. Knowing just what happens with the movement

of contamination from the site of a nuclear test can aid in studying underground disposal of high-level radioactive wastes.

Work is still underway at the Radionuclide Migration (RNM) Project, but results so far show that 10 years after the nuclear test, most of the radioactivity is still in the fused debris in the region of the explosion. No radioactivity was found 50 meters below the blast cavity.

And, water directly from the cavity shows only strontium-90 and tritium at levels higher than the recommended concentration guides for drinking water in uncontrolled

Photos by Bill Jack Rodgers

areas. (There are several other radioactive elements present in water in the cavity that apparently have leached in small amounts from the fused debris.)

"In order to study the migration or radionuclides from the test region, we drilled into the original cavity and examined both the groundwater and the solid material," said Bill Daniels, LASL's scientific director for the project. "Later, we pumped water from a well 91 meters away to see if we could pull radionuclides present in the water from the Cambric cavity through the alluvium to the satellite well."

Now under study are the migration of radionuclides under forced-flow conditions (in the field), and the leaching and sorption properties of fused debris and geologic media with ground water (in the laboratory).

The Radionuclide Migration Project is sponsored by the Nevada Operations Office (NVO) of the Department of Energy. Several organizations are involved, including IASL, the Lawrence Livermore Laboratory, the U.S. Geological Survey, the Desert Research Institute, and support agencies. The project manager is R.W. Newman of NVO. J.E. Sattizahn and D.C. Hoffman have served as LASL technical directors, while R.H. Ide and L.D. Ramspott have held that post for Livermore. Bill Daniels is with IASL's Nuclear Chemistry Group (CNC-11) of the Chemistry and Nuclear Chemistry (CNC) Division.

Reasons behind Cambric

Cambric was chosen for study for many reasons. It took place in an alluvium consisting primarily of particles of volcanic tuff that permit a fairly rapid, uniform groundwater flow. The natural flow rate in the undisturbed aquifer is very low.

The yield from the explosion was small, so there should have been little long-term effect on local hydrology. Groundwater had fairly quickly refilled the cavity and chimney to the pre-test level, and

Ten years after the test, most of the radioactivity is still in the fused debris left from the blast. No radioactivity was found 50 meters below the cavity.

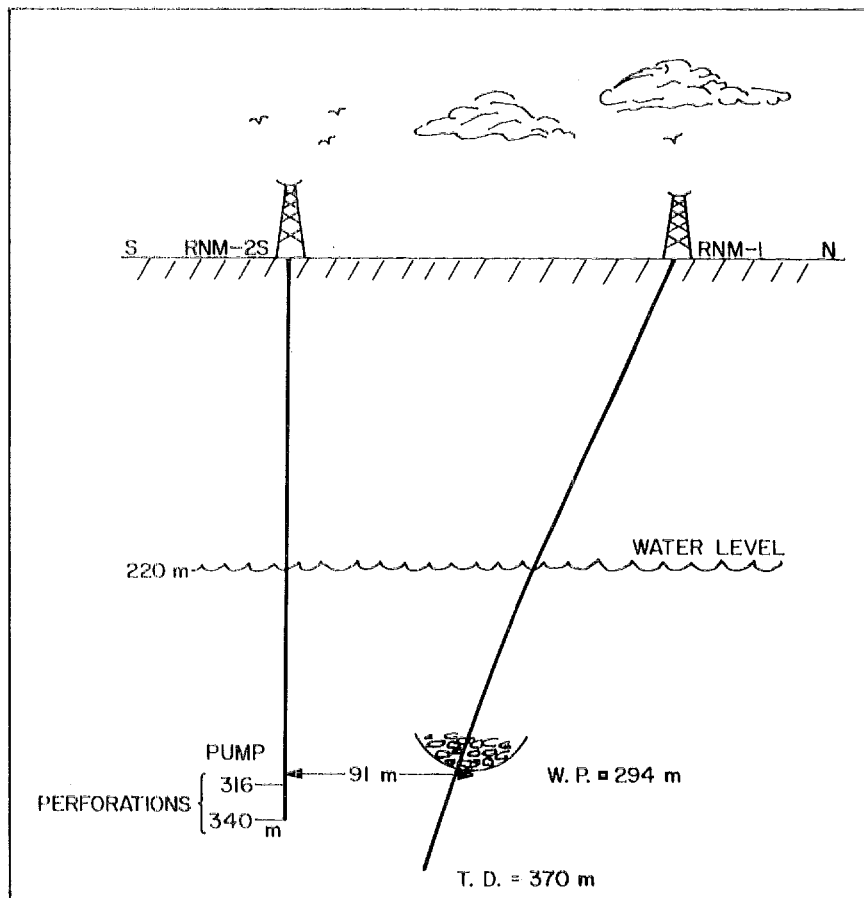
had been in contact with the debris for about 10 years, allowing time for leaching to occur.

Tritium (^3H or T) was present in readily measurable amounts and could be used as a tracer for water from the test region. (Tritium is a radioactive isotope of hydrogen and replaces normal hydrogen in water molecules, forming HTO .)

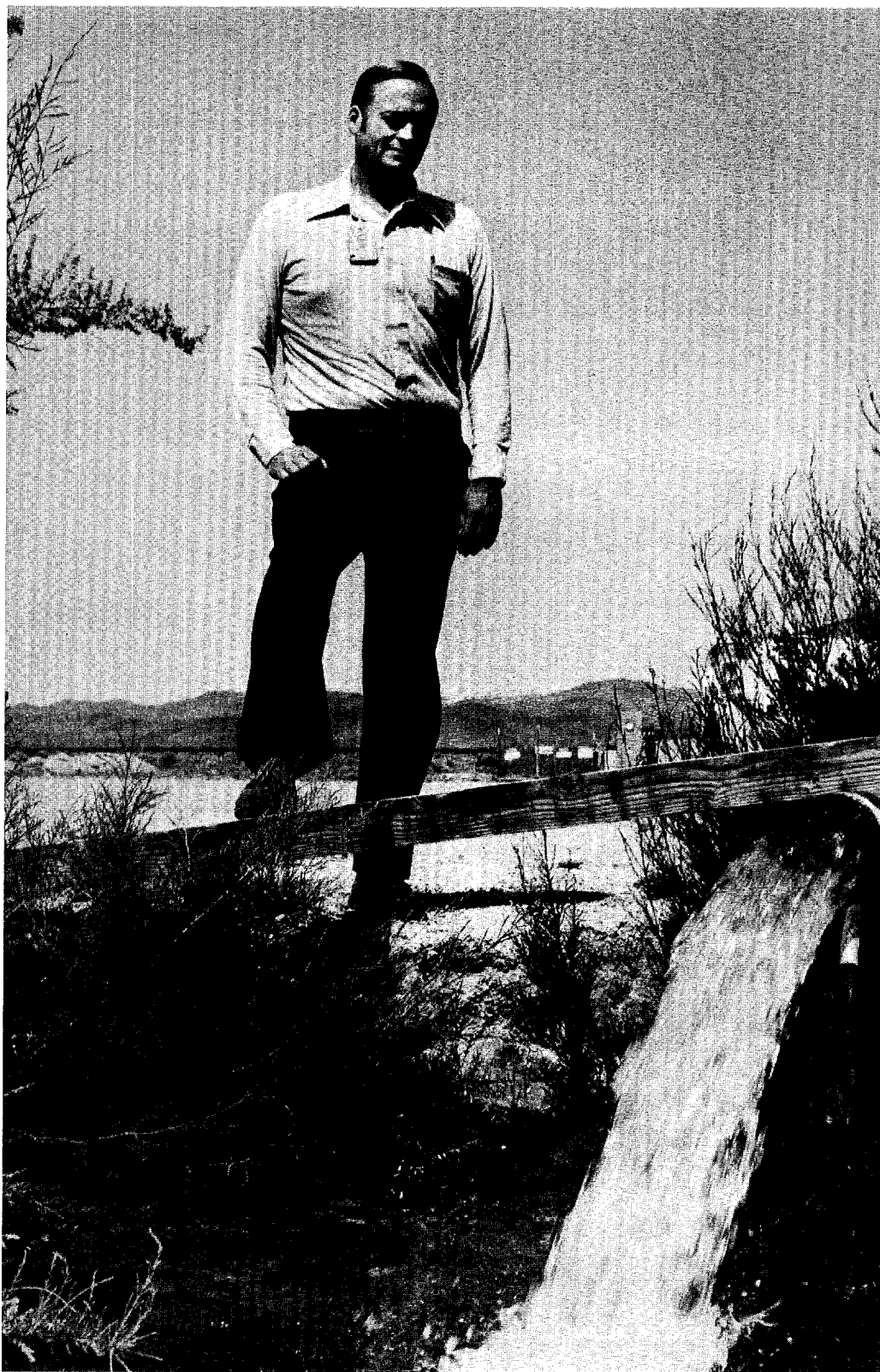
Researchers first had to measure the concentrations of radionuclides at Cambric; the re-entry hole, named RNM-1, was drilled in May

of 1974. The satellite well (RNM-2S) had been drilled earlier to avoid the possibility of cross-contamination from Cambric.

During the drilling of the re-entry hole, a total of 67 sidewall core samples were taken at depths ranging from the surface to about 50 meters below the detonation point. Some of these cores were placed immediately in gas-tight, stainless steel containers for later analyses of krypton-85, HT , and HTO . Other cores were sealed in

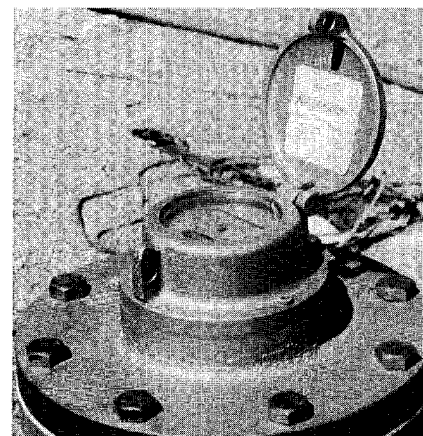


The Cambric study in cross-section: The re-entry hole, RNM-1, was drilled in May of 1974 and samples were taken along its path. The satellite well to draw water, RNM-2S, was drilled earlier to avoid any cross-contamination from the blast cavity.



'Lake Darleane' has resulted from the four years of pumping at the Radionuclide Migration Project, as Bill Danielson, CNC-11, shows. Greenery graces the shoreline and waterfowl pause on the surface; any contaminated pumped water is dealt with properly.

Tritium was finally detected after 380 million gallons of water had been pumped. Rough calculations show that, at this rate, most elements would require 1,500 years to travel. Even in water in the cavity, plutonium is less than a tenth of a percent of the permissible level.



Flow meter keeps track of water pumped from satellite well. The rate has now been increased to 600 gallons (2.3 cubic meters) per minute.

water-tight plastic bags for subsequent radiochemical analyses.

Cores were also analyzed for other radionuclides by observation of gamma-ray spectra. Both solids and liquids from a representative cavity core sample were analyzed for several radionuclides.

The result for each nuclide may be expressed in terms of a "distribution coefficient," which is the ratio of the radioactivity concentration in the solid to that in the water: strontium-90, about 10^4 ; cesium-137, equal to or greater than 10^4 ; plutonium-239, about 10^8 . A high value indicates that the fraction in the undisturbed aquifer is very low.

Devices called packers were used to isolate portions of the drill hole so water samples could be taken at selected depths. Again, some samples were taken in gas-tight containers while others were taken in plastic bottles.

Activity confined

Most of the radioactivity found in the groundwater was still in the

original cavity region. Tritium, krypton-85, strontium-90, ruthenium-106, antimony-125, cesium-137, and plutonium-239 were detectable. But only the tritium and strontium were present in concentrations higher than the recommended guides for drinking water. More than 99.9 per cent of the tritium was present as HTO in the water.

Since the amount of each radionuclide resulting from the nuclear test was known, an estimate could be made of the fraction of a radionuclide that had leached from the solid and was now present in the water. These ranged from about one per cent of the ruthenium to about two-millionths of a per cent of the plutonium.

"Most of the activity never left the solid material," said Daniels. What little did leach from the fused debris was still present almost entirely in water in the original cavity.

The extremely low concentrations of plutonium in the water are probably due both to low leaching

rates, and to plutonium's insolubility in the slightly basic water at Frenchman Flat. Even in water in the cavity region, the plutonium is less than a tenth of a per cent of the permissible level.

A new lake

After the radionuclide content of the groundwater in the test region had been determined, the second phase of the study began.

The pump on the satellite well, RNM-2S, was turned on in October of 1975. The flow rate was 250 to 300 gallons per minute, or a cubic meter per minute. This was expected to overcome any natural water flow, and draw water from the Cambrian cavity to the satellite well. Detection of tritium in the water would signal the arrival of water from Cambrian.

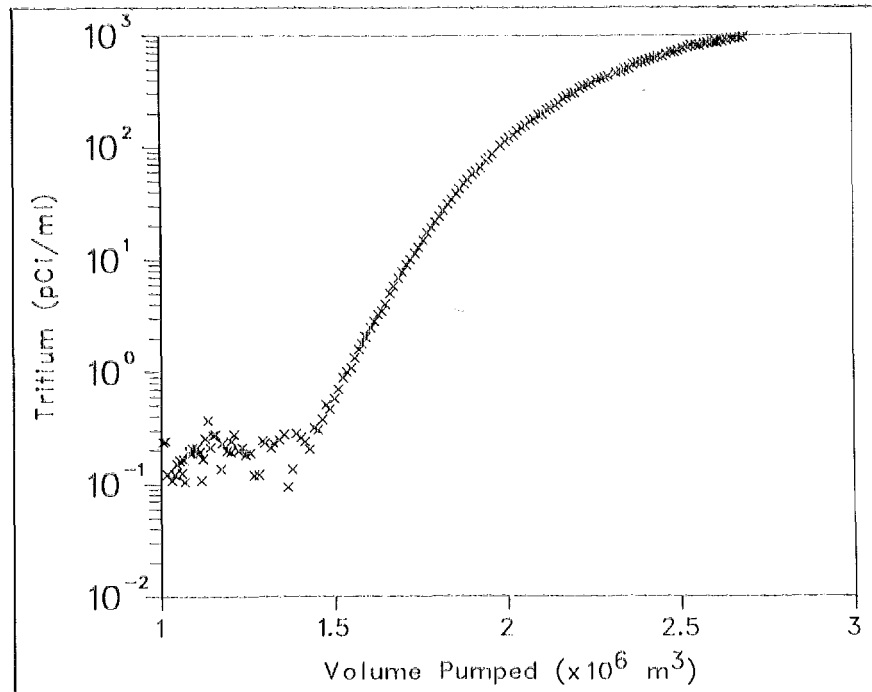
About 300 million gallons (1.14 million cubic meters) were pumped over the next two years, enough water to create a new lake (dubbed Lake Darleane) on an old lake bed, where waterfowl now pause and greenery graces the shoreline.

"We saw no tritium, no radioactivity of any sort, in the water during that time," Daniels added.

Pumping was suspended, and the water in the Cambrian cavity was checked once again through the original re-entry hole. The tritium concentration had decreased by a factor of 50. Water had left the Cambrian cavity but had not traveled the 91 meters to the satellite well.

In October of 1977, a higher capacity pump was installed and the rate was increased to about 600 gallons per minute (2.3 cubic meters per minute). Tritium was finally detected after a total of about 380 million gallons of water had been removed. Water from Cambrian had arrived at the RNM-2S well.

"Our laboratory measurements," Daniels said, "show that most elements have distribution coefficients greater than a hundred. Rough calculations show that over 1,500 years would be required for these to travel the 91 meters at current pumping rates.



Over time, the amount of detectable tritium in the water pumped at the Nevada Test Site project has risen. This plot from CNC-11 shows tritium (in picocuries per milliliter) versus water volume (in millions of cubic meters).



DOE photo

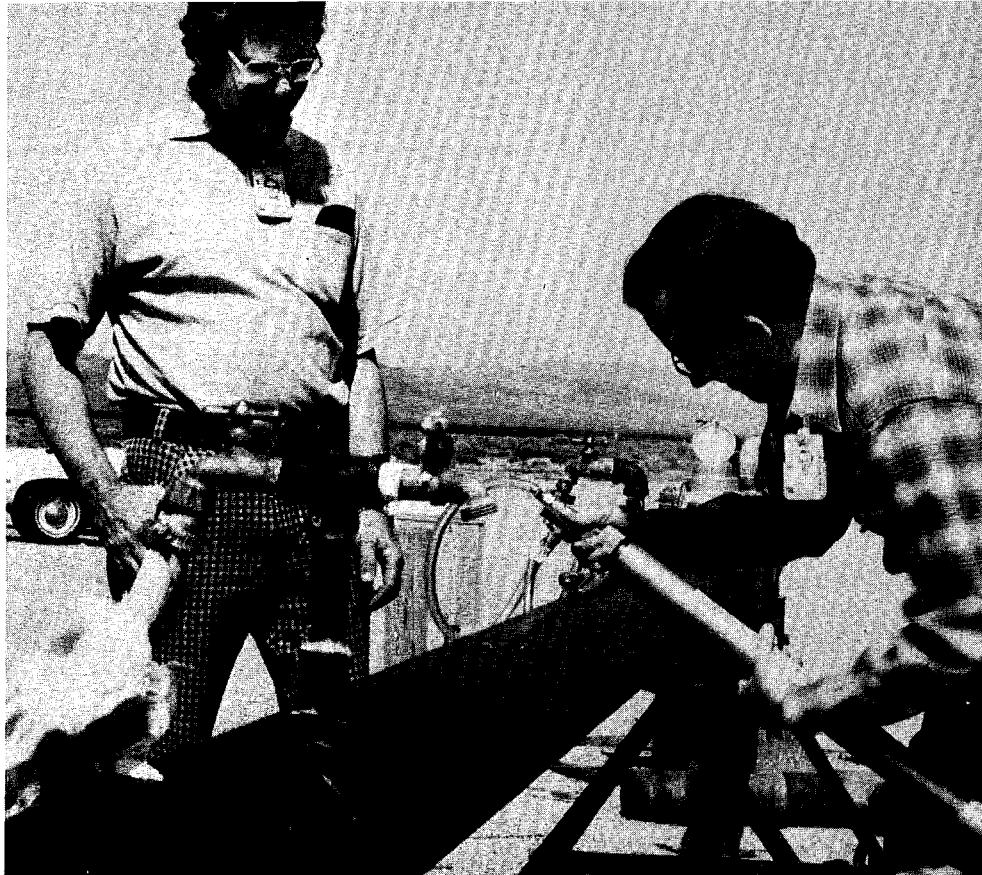
Project manager R.W. Newman said Los Alamos and Lawrence Livermore laboratories have been studying the exchange properties of soils at the Nevada Test Site. The actual peak of the detected radiation could only be determined by a Cambric-like study.

"We are now checking for other possibilities, such as the presence of elements with very slow or slow sorption, or of colloidal species, which might allow radionuclides to move more rapidly than we expect." This is done by boiling down 55-gallon water samples and examining the residues for radioactive isotopes.

Pumping at the satellite well will be continued to find out when the tritium concentration peak will occur, and to see if other radionuclides can be moved through 91 meters of alluvium.

Another test site may be selected to study radionuclide migration at early, as well as late, times. A study above the water table may also be considered.

'The tritium level is rising but is still less than a third of that permitted in drinking water . . . the water is still drinkable.'



Kurt Wolfsberg and Bruce Erdal, both of CNC-11, take a water sample from the outflow pipe to check the pH content of the water, which is slightly basic. Below, Wolfsberg uses a pH meter to sample drums, destined for further laboratory analysis.

LASL participation in the project has involved about 15 people off and on since 1974, mostly from CNC-Division and the Field Testing (J) Division. The Laboratory can continue with a few people, the equivalent of two full time persons per year, because all the preliminary work has been done. With new drilling, however, the manpower needs will increase.

Still drinkable

"We have now pumped about 700 million gallons," Daniels said. "The tritium level is rising but is still less than a third of that permitted in drinking water. The only radioactivity we have seen, other than tritium, is krypton-85, a noble gas element which acts like it's dissolved in water. And the water is still drinkable."



Genetic hazards and the law

It was only in 1973 that biologists and genetics researchers seriously raised questions about certain DNA experiments and "began to think... in scenarios that were really quite frightening," a Los Alamos colloquium audience was told.

But, speaker Margery W. Shaw concluded, "The magnitude of the risk... has nothing to do with the anxiety provoked."

Shaw is director of the Medical Genetics Center at the University of Texas. She received her M.D. in 1957 from the University of Michigan and a J.D. degree in 1973 from the University of Houston. Her twin expertise in medicine and law has focused most recently on the legal and social aspects of genetics research; at LASL, her topic included recombinant DNA.

Changes in the base makeup of DNA, a genetic carrier, can cause gene mutations in organisms. In the early 1970s, scientists discovered that certain enzymes can cut and splice hereditary material in a precise way. Hybrid DNA molecules can be created in a biological "scissors and paste" method, hence the term "recombinant DNA."

The technique can be used to learn more about the genetic makeup of any organism, including hu-



Photo by Bill Jack Rodgers

Margery Shaw: Scientific research should not be hampered by the government unless a "clear and present danger" can be proven.

man, but there are hazards. Adding new genes to bacteria and viruses, for example, could confer qualities that could be harmful to other forms of life with possible epidemic proportions.

In an appeal for a moratorium on such DNA work until a better rationale was developed, said Shaw, a group of scientists in the field published a public letter in 1974 on the potential hazards of recombinant molecules. Eventually, the National Institute of Health issued stringent guidelines regulating such work in 1976. By 1978, she said, the controversy seemed to have faded from the limelight, partly because the research by then was not as unknown as five years before.

Toxic substances such as bacteria and viral strains had been research topics for years in laboratories, said Shaw, yet persons were not living in

fear of that danger. Cigarettes and automobile operations are each responsible for thousands of deaths each year, she added, but society, although forewarned, does not react negatively to these activities.

"People are most afraid of the unfamiliar. We have less fear over what we can control," said the speaker. An example of anxiety following outer space travel is the quarantines imposed upon the first American lunar explorers, after they returned to earth.

Recombinant DNA research was controlled by the government for largely irrational reasons, she said; people in positions of influence felt the need to regulate the science until public anxieties had lessened. Partly, those anxieties were triggered by such events as a "horrible abuse" of elderly patients given unsanctioned injections in New York, and by an unconscionable syphilis experiment with black men in Alabama.

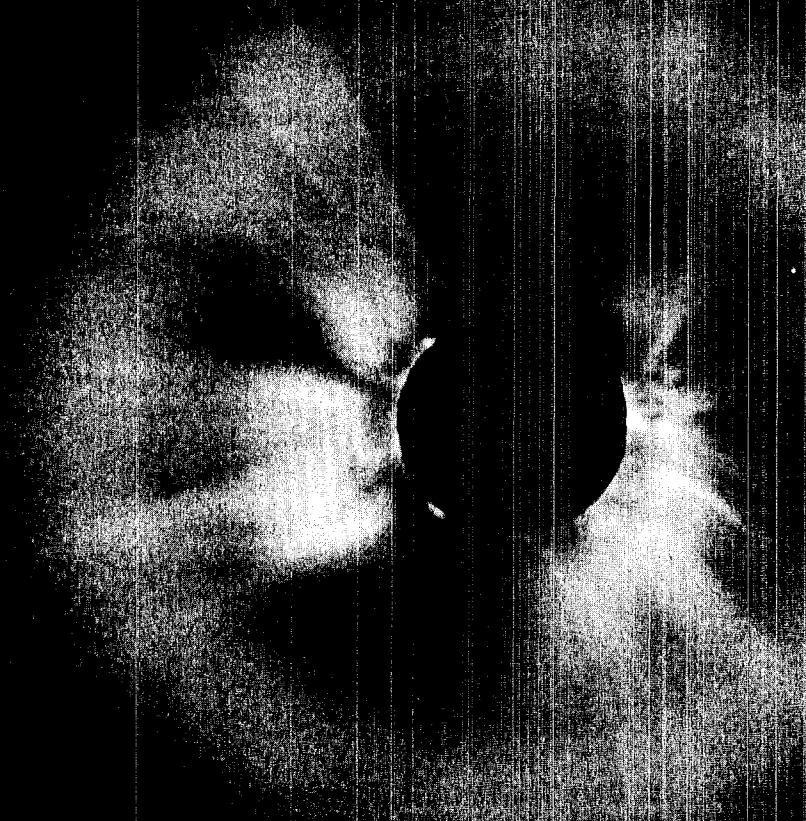
But we do allow such tinkering as heart and kidney transplants, said Shaw, while we are frightened by changes dealing with either the thinking process or reproductive systems. That is some hypocrisy, she said, because we treat people with genetic problems, and even allow them to reproduce.

"Education itself is a form of brainwashing," Shaw asserted, as is psychotherapy and cultural assimilation.

Legally, court decisions involve one right clashing with another right. Scientific freedom must be balanced with the public's right not to be infringed upon, said Shaw. The main guide in whether to regulate is deciding whether scientific research presents a "clear and present danger" to society.

—Jeff Pederson

Eclipse 1979



Moon passed between sun and earth over North America in late February, leaving only the sun's corona visible to LASL observers aboard an Air Force plane. Above much of the earth's atmosphere, Bill Regan and Brook Sanford made this picture with a special radial-filtered camera.

By John Armistead

An Air Force NC-135 jet screamed down the flight line at Kirtland Air Force Base in Albuquerque early in the morning of February 26, lifted its cargo of scientists and equipment, and headed for North Dakota.

At 40,000 feet over northwestern North Dakota, the jet reached its destination—the path of the total eclipse of the sun.

Between 9:36 and 9:40 a.m. New Mexico time, the sun, moon, and earth were in perfect alignment, creating a regular and always fascinating event. Los Alamos Scientific Laboratory scientists began experiments for which they had prepared intensely for 4 weeks.

The researchers wanted color and black-and-white photographs of the eclipse, and also information to help check measurements of the earth's rotation speed.

And photographs they did get. "Perhaps some of the best we've ever taken," said Charles "Chick" Keller, J-15 group leader and one of the LASL participants in the solar eclipse expedition.

Using special photographic equipment, designed and fabricated

Using special equipment, the scientists were able to get detailed photos of coronal streamers from near the sun's surface out to great distances. The photos were some of the best ever taken.

at LASL, and a Hasselblad camera with a radially graded filter made specifically for eclipse events, the scientists were able to get numerous detailed photos of coronal streamers from near the surface of the sun out to great distances. These streamers were photographed to at least twice the distance seen by ground-based observers.

Involved in photographic experiments, in addition to Keller, were Bobby Strait, C-9, M.T. "Brook" Sandford, J-9, Bill Regan, ISD-DO, and David Moore, PUB-DO. Bill Roach, J-12 group leader, acted as LASL liaison for all the participants, a job that included helping navigate the aircraft to the eclipse path.

Art Cox, T-DO-7, compared his observations of the exact times of total eclipse with predictions made by Don Eilers and Barbara "Bobby" Melton, both J-15.

Poring over negatives and photographs from the experiments, Sandford, Keller, Cox and the others obviously were excited and satisfied with their efforts.

They feel the data from these photographs will add to knowledge about the sun's corona or outer atmosphere, especially about the outer corona, which can only be photographed above the earth's atmosphere, and about the distribution and shape of the corona's most obvious features, its streamers. These define the shape of magnetic field lines as they are drawn into interplanetary space by the expanding corona.

Eclipses of the sun are frequent events, and always scientists study them. So why keep going on eclipse missions? Don't we already know enough about what happens?

No, say the LASL researchers. The scientific community must



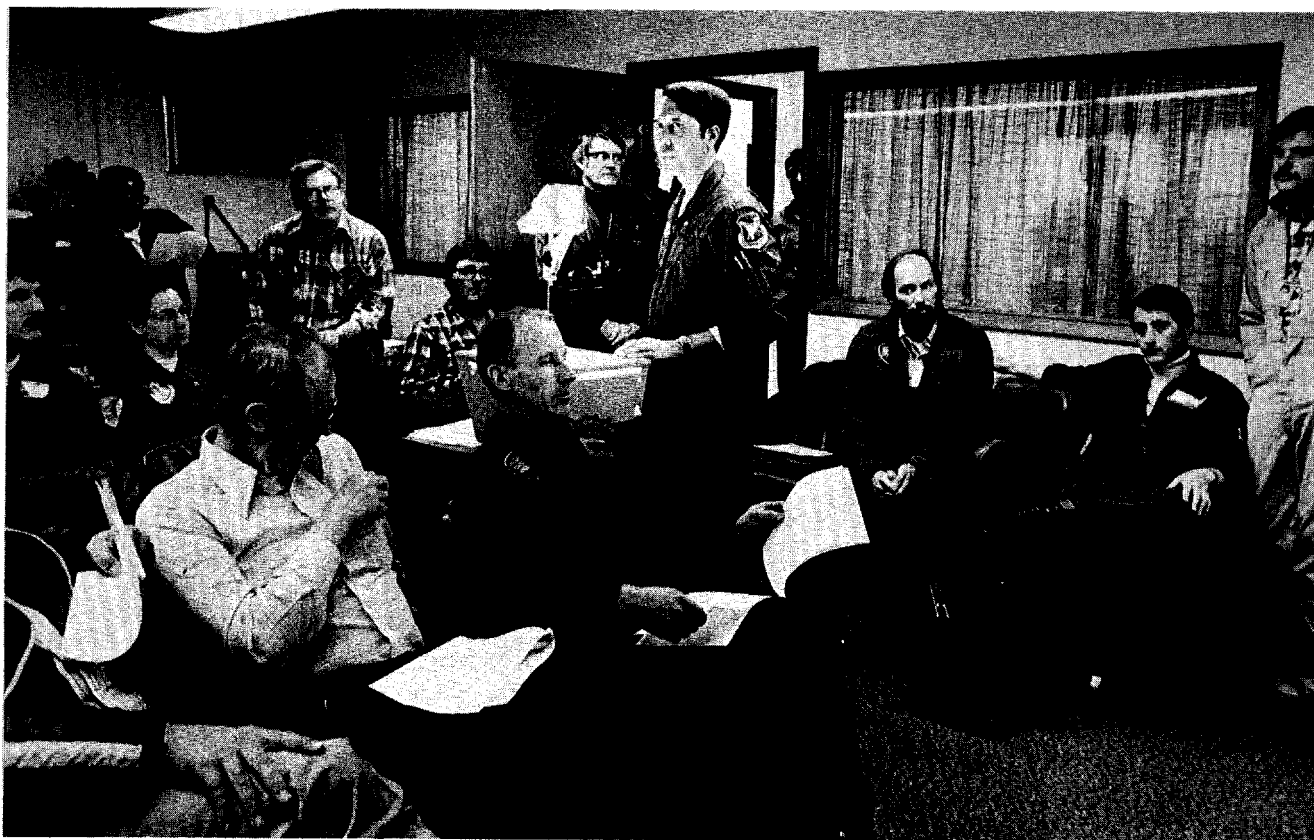
The Air Force NC-135 was ready for takeoff to North Dakota before the sun had risen over Albuquerque February 26.

Photos by LeRoy N. Sanchez

Los Alamos observers have flown on six eclipse expeditions in the past 15 years. Their discoveries have included high coronal temperatures and new emission lines at infra red wavelengths.



The eclipse experimenters created a logo for their mission: "See 79."



A pre-flight meeting at Kirtland Air Force Base included experimenters and the aircraft's crew, along with representatives of national media.

continue to track, record data from, and interpret solar eclipse events both because the sun changes constantly and there is always new information to be gained, and because new observation equipment allows studies of the corona that were previously impossible.

LASL observations are made as part of a much larger effort of solar astronomers to understand the corona. Two main questions are being asked: (1) How does the sun's 6000 degree C surface heat the corona, where temperatures exceed one million degrees? (2) Precisely how and where in the corona does the solar wind form?

Solar wind

The solar wind consists of charged particles which stream out

from the sun and blow past the earth at speeds of more than 400 km/sec. Much of our knowledge of the solar wind near the earth has come from LASL astronomers in P-Division. Yet the connection of what is seen at the earth with occurrences on the sun and its corona is poorly understood.

This solar wind interacts with the earth's magnetic field, which channels the charged particles toward the earth's poles. During periods of intense solar activity, bursts of such particles in the solar wind cause such polar phenomena as aurora and geomagnetic storms that degrade radio transmissions.

It is also thought that this wind interacts with the ionosphere in subtle ways, triggering dramatic

changes in our weather patterns. One example is the apparent connection of the high plains droughts in the U.S. with the 22-year sunspot cycle on the sun.

Sunspots are regions of considerable magnetic activity on the sun's surface. The number of sunspots waxes and wanes over an 11-year cycle and is indicative of a similar variation in all solar activity, both on the sun's surface and extending through the corona to the solar wind.

Keller said LASL observers had flown to previous eclipses in 1965, 1966, 1970, 1972, and 1973, as well as in 1979. These expeditions yielded such firsts as the discovery of extremely high coronal temperatures in excess of 5 million degrees; discovery of new emission lines at infra red wavelengths; a "one-of-a-kind" image enhanced photograph of the 1973 eclipse showing streamer evolution from the base of the corona out to 12 solar radii, and during this recent eclipse the first observation to 20 solar radii in 16 years. In addition, data on electron density in the outer corona have been obtained during various parts of the solar activity cycle.

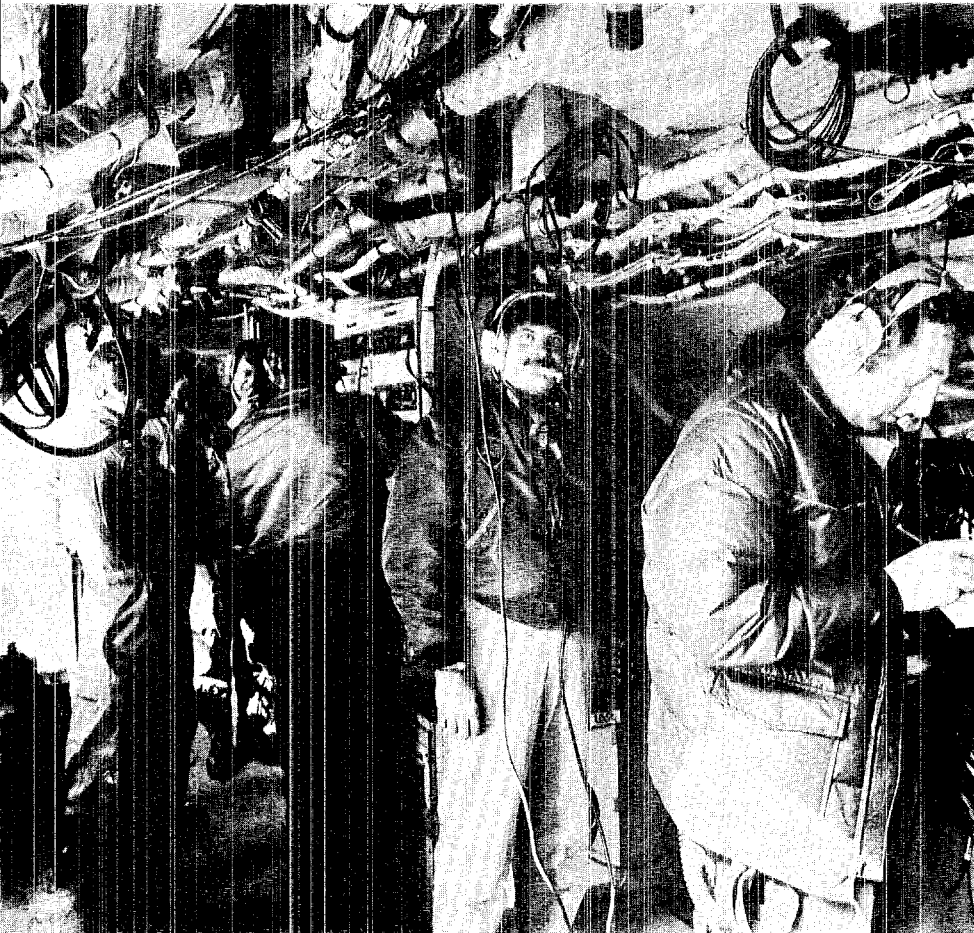


Photo by Bill Regan

"Brook" Sanford of J-9, looking into the camera, was co-experimenter with Bill Regan for a radial filter series of the solar eclipse.

The solar wind consists of charged particles streaming out from the sun and blowing past the earth at more than 400 kilometers per second. The wind interacts with the earth's magnetic fields; it can cause aurora and geomagnetic storms.



Art Cox of T-Division manned an instrument console in the plane during the eclipse mission.

Keller said that the 1979 eclipse showed the corona to be nearing maximum activity and is a valuable addition to this data.

In 1980 the current cycle will peak. This is a fascinating time for astrophysicists to be studying solar activity. And the best way to record data of this activity is during a total eclipse. "That's why we will always want to study eclipses," added Keller.

Keller and his coworkers want to know, for instance, if the solar wind that blows by the earth comes out of the poles of the sun, and what part the streamers play in formation of the solar wind. They want to know more about the density of the sun's corona at large distances from the sun.

The moon, during the eclipse, blocks out most of the light except some of the chromosphere, the region near the surface of the sun where the ionized hydrogen gases appear reddish. The coronal light itself is caused by scattered sunlight. It is scattering off electrons moving outward in the streamers, and to a lesser extent in coronal

holes between streamers. The corona, therefore, appears basically "sun-colored."

Keller mentioned that the Apollo Telescope Mount aboard Skylab monitored the corona daily for more than a year. This data greatly increased knowledge of the corona but was at a time of low solar activity, quite unlike that observed at the eclipse this year. Cross comparison of LASL's coronal data from the 1973 eclipse with Skylab's results on the same day proved very helpful to both groups.

Most importantly, only the LASL data extended far enough from the sun to be compared with Skylab and so provided an important check on the validity of the Skylab work. In fact, as a result of these comparisons, the Skylab values had to be revised downward by about 10 percent.

'The rotation speed of the earth has diminished by 50 seconds since the beginning of this century . . . for astrophysicists it is quite significant.'

Cox points out the interest in knowing the rotation speed of the earth. "The rotation speed of the earth has diminished by 50 seconds since the beginning of this century. It may not seem crucial to the average person on the street, but for astrophysicists it is quite significant," he said. "This slowing of rotation does affect the earth, and of course it forces the people who determine exact times worldwide to correct their atomic clocks."

Special filter

The modified Hasselblad camera used in some of the photographic efforts on the recent mission was equipped with a radially graded filter, made especially for eclipse experiments. The filter is made of glass that is coated with aluminum; it is dense at the center and becomes less dense (graded) toward the edges. It allows taking a photograph of the total eclipse that has a correct exposure of the brightest and dimmest parts of the eclipse.

The filter is mounted in the camera at a point where it almost touches the film in the back. The lens used in this expedition was a standard Hasselblad 500mm telephoto. With this apparatus the team was able to get pictures of the corona and the ionized gases in the chromosphere.

The other camera used was designed and built here at LASL. It accommodates 70mm film, has gyros built right into it so that it tracks on the eclipse at all times, and it is outfitted with a special 600mm telephoto lens designed by Berlyn Brixner of M-Division.

This telephoto has six lenses in its tube, but the lenses are doublets, or 2 lenses cemented together and spaced appropriately in the tube. The lenses are designed to focus best

in the red part of the spectrum.

Cost of the eclipse mission is low, compared to sending a satellite aloft. Discounting the researchers' time, the primary expense was for flying time in the Air Force plane. LASL's cost was about \$10,000.

"This is incredibly cheap," said Keller. "LASL, a large, multidisciplinary scientific laboratory, is riding on a wave of achievement and knowledge. If we want equipment for eclipse experiments, we don't have to invest large sums of money. Most of the equipment is available, and much of it can be borrowed."

Keller mentioned that at least six LASL divisions or groups usually get involved in eclipse missions, and in interpreting the data gathered during such missions.

The next total eclipse will be in 1980 over the Indian Ocean; LASL hopes to record data then as solar activity reaches its peak.

1980 Peak

"We just observed the most active corona since 1970, and maybe the most active one we've ever observed. We think the data we got from this one will be valuable in leading to preparations for the great total eclipse in 1980 over the Indian Ocean, when solar activity reaches its peak," Keller said.

The ultimate understanding LASL scientists are striving for is to help determine the role of the corona in transmitting energy from

the sun to the solar wind. In the end, they would like to understand this well enough to be able to predict how a given set of events on the sun's surface will affect the earth.

"This expedition we just finished stands on its own. We got much new information," said Keller, "but we are looking forward to 1980 and the possibility of being involved in what could be an even greater, and more beautiful, show of nature's power."



Mission completed, the Air Force plane, carrying experimenters, television crews, and undeveloped LASL film, is directed home at the end of the day.

Short subjects



Photo by Jeff Pederson

Robert N. Thorn

Robert N. Thorn was named Acting Director by the Regents of the University of California, effective March 1. He presently is associate director for weapons at LASL and his temporary appointment apparently will last until the Regents nominate a permanent successor to Harold Agnew. Thorn said he planned no major changes in Laboratory structure and said he would deal with unforeseen developments as they occur. He received a Ph.D. in physics from Harvard University in 1953 and joined LASL shortly thereafter. He is a 1967 recipient of the E.O. Lawrence Memorial Award for achievement in nuclear physics.

* * *

Darleane C. Hoffman will become leader of the Chemistry and Nuclear Chemistry (CNC) Division as of July 1, 1979. She will succeed George A. Cowan, who earlier announced his intention to step down. Hoffman, an associate group leader in CNC-11, is now on professional leave as a Guggenheim Fellow at Lawrence Berkeley Laboratory. She received a Ph.D. in physical chemistry from Iowa State University, and began working at LASL in 1953. Her current fellow-



Photo by LeRoy N. Sanchez

Darleane Hoffman

ship is for studies of mechanisms of the nuclear fission process. Hoffman also is chairman of the Division of Nuclear Chemistry and Technology of the American Chemical Society for 1979.

* * *

LASL's Office of Government and University Relations has been dissolved. It was headed by Frank C. DiLuzio, who is now heading the Office of Institutional Relations and Technology Liaison. David Freiwald is DiLuzio's assistant. The change is part of the Laboratory's effort to build a better constituency with regional universities and industry. The new office will also work with Congressional committees and government agencies. The federal government has spent money for research and development at national laboratories, but the difficulty has been to make industry aware of the opportunities.

* * *

Raymond Morrison will serve a three-year term as a director of the Continuing Professional Development Division of the American Society for Engineering Education on July 1, 1979. He currently is leader of the Personnel Training Group (PER-5); he also has worked in the Los Alamos public school system and with the University of New Mexico branch campus here. Morrison received a Ph.D. in 1975 from the University of Missouri.

* * *

A 30-minute special television program titled "Nuclear Energy: A Viewpoint" was aired on Sunday, February 25, by KNME-TV over channel 5 from Albuquerque. It featured an interview with outgoing Director Harold Agnew and followed another show, a Public Broadcasting Service documentary called "Paul Jacobs and the Nuclear Gang." Agnew said we are always exposed to low level radiation through natural and manmade sources such as x rays; and he said radiation can cause cancer but can also kill certain types of cancer. The Director refuted conclusions of a study by Thomas Mancuso and said inhalation of hot particles such as plutonium does not necessarily cause cancer. On hand during the

interview was LASL staff member William Gibson, who said the only difference in his health now, as opposed to the time he inhaled the equivalent of 6 maximum permissible body doses of plutonium in the early 1940s, was that he had put on weight.

* * *

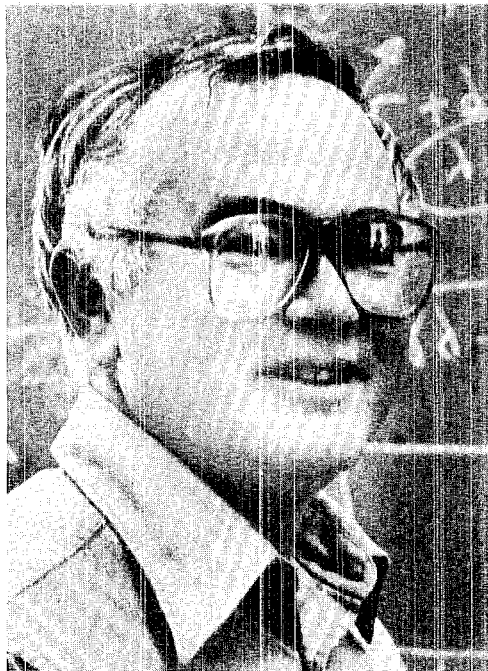


Photo by LeRoy N. Sanchez

Peter Carruthers

Peter Carruthers, head of the Theoretical (T) Division at Los Alamos, has been appointed to the High Energy Physics Advisory Panel that advises the Department of Energy on the status and future facilities of its high energy physics program. Carruthers was at the same time appointed U.S. coordinator for particle physics, in conjunction with his membership on the National Academy of Sciences Committee on U.S.-U.S.S.R. cooperation in physics. Carruthers will be on the committee for the 20th International Conference on High Energy Physics, scheduled for 1980 in Madison, Wisconsin. Carruthers has headed T-Division since 1973; he also has authored three books.

* * *

The Department of Energy study group that is to report on the relationship between the University of California and the U.S. weapons laboratories met in Los Alamos March 20. Frequently referred to as the Buchsbaum Committee, the group held discussions with Laboratory managers before a public meeting was held in the Administration Building. The committee is headed by Solomon Buchsbaum, vice president, Bell Laboratories. It is to review and comment on the status of the University's management of the laboratories and to say how the relationship should evolve to best serve the needs of the country. The group's tasks were earlier outlined by DOE Secretary James Schlesinger. Present contracts to operate LASL and Lawrence Livermore Laboratory expire in 1982; within DOE, the laboratories are responsible to the assistant secretary for defense programs.

* * *

Universal Building Company of Albuquerque has been awarded the contract for building the \$227,000 University House at LASL. This 3,300-square-foot structure will be located in a pine grove near the main library and is intended as a small meeting and conference area. It is to have a campus faculty house atmosphere and will be outside security areas. Construction will begin this spring, with completion scheduled for later in 1979. Project architects are Mark Jones and Gordon Albury, Jr., of LASL's Engineering Department. They said the building is designed for energy conservation and reflects the Santa Fe architectural tradition. It will be operated by the Public Relations Department.

* * *

Patents awarded

United States patents have recently been assigned to Los Alamos researchers in three instances.

Stephen D. Rockwood of the Applied Photochemistry (AP) Division was awarded Patent 4,088,553, or "Method for Separating Boron Isotopes." His method of separating boron-10 and boron-11 uses laser-induced selective excitation and photo dissociation of molecules containing a particular boron isotope. Photodissociation products react with a chemical scavenger and may readily be separated from undissociated BCl₃.

William A. Steyert, Jr. of the Energy (Q) Division was awarded Patent 4,107,935, or "High Temperature Refrigerator." His design uses a Stirling-like cycle in which rotating magnetic working material is heated in zero field and adiabatically magnetized, then cooled in high field and adiabatically demagnetized. The working material is in heat exchange with a fluid that absorbs heat from a low temperature source and deposits heat in a reservoir.

Anton Mayer of the Chemistry-Materials Science (CMB) Division was awarded Patent 4,109,612, or "Electroless Plating Apparatus for Discrete Microsized Particles." His method produces very uniform coatings of a material on discrete microsized particles by electroless techniques. Agglomeration of the particles during deposition is prevented by imparting a random motion to them so they are not in contact with each other for a sufficient time.

Among our visitors



Photo by LeRoy N. Sanchez

Lt. Col. Butler Franklin (left) was one of 13 instructors and staff members who visited LASL for updates in March. The group was from the Interservice Nuclear Weapons School at Kirtland Air Force Base. Enjoining Franklin in an animated discussion is Ed Stein (right), leader of the Visitor Relations Group (PUB-3).

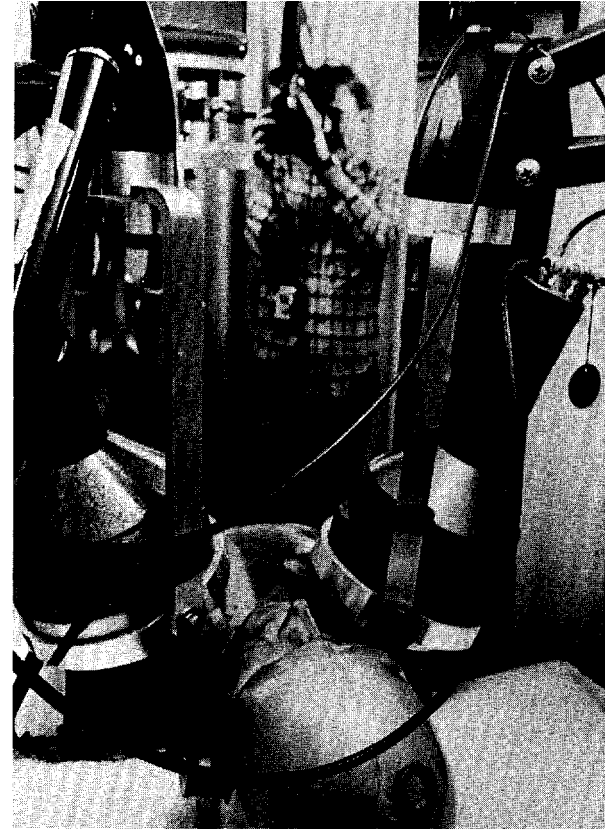


Photo by LeRoy N. Sanchez

The whole body counter, used to detect radioactivity in a person, was filmed at the Health Research Laboratory by a BBC film crew; Bob Perrin is operating a camera in the background while a model takes the place of a person being analyzed. The crew spoke with John Umbarger, H-1, and Don Peterson, H-Division alternate leader, during their stay.



Photo by Bill Jack Rodgers

Maj. Gen. Robert W. Bazley, U.S. Air Force (left), heard about LASL programs and toured several facilities during a day-long visit here. He was accompanied by Col. Wendell E. Cosner (right), the director of nuclear surety at Kirtland Air Force Base in Albuquerque. Bazley is deputy inspector general and commander of the Air Force Inspection and Safety Center at Norton Air Force Base. He has been the assistant for readiness of U.S. Air Forces in Europe, with headquarters at Ramstein Air Base, Germany.



Photo by Bill Jack Rodgers

B.J. Luberoff, editor of Chemtech magazine, presented a colloquium dealing with communication channels. He founded the magazine in 1971 to provide a forum within the chemical industry. Luberoff, a licensed engineer, holds several dozen foreign and domestic patents.



Photo by LeRoy N. Sanchez

Cayetano Ortiz, left, of group H-1, demonstrated a radiation counting device to William S. Heffelfinger, right, during a LASL visit. Heffelfinger is director of administration at Department of Energy headquarters and was joined by nine other DOE administrators from around the country.



Photo by LeRoy N. Sanchez

Several wives of state legislators toured the low-level nuclear waste burial site at Los Alamos Scientific Laboratory March 9. Their guide, Tom Keenan, is leader of the Waste Management Group (H-7). He told them burial operations of low-level products have been carried out safely for decades in the volcanic soil of the Pajarito Plateau.

10 years ago

'MESON FACTORY' UNDER CONSTRUCTION

Today, a LASL research team is using the 184-inch synchrocyclotron at the University of California's radiation laboratory in Berkeley to acquire data that will assist in the final design of a "meson factory." More properly called the Los Alamos Meson Physics Facility (LAMPF), this accelerator is on schedule with a 1972 completion date. LAMPF experimental areas may require angles of up to 90 degrees or more for production of pion particles from the main proton beam line.

MORE CARBON-13 FOR RESEARCH

Of naturally occurring carbon, most is carbon-12. But carbon-13 also has applications for research; it is stable and is detectable on living organisms when nuclear magnetic spectrometers are used. At LASL, three distillation plants to produce carbon-13 at a reduced cost are being built. Two will produce 95 percent carbon-13, and one will enrich the refined isotope to 99 percent. The work is under Group CMF-4.

TWO ARE NAMED LAWRENCE AWARD WINNERS

Los Alamos scientists Don T. Cromer and F. Newton Hayes are two of the five persons receiving the Atomic Energy Commission's coveted Ernest O. Lawrence Memorial Award for 1969. Each award carries a citation, medal, and \$5,000; ceremonies will be at the end of the month in Washington, D.C. Cromer, leader of CMF-5's Crystal Chemistry Section, contributed to the knowledge of intermetallic compounds of plutonium. Hayes, leader of the H-4 Molecular Radiobiology Section, contributed to our knowledge of scintillation counting. LASL now counts nine Lawrence Award winners.

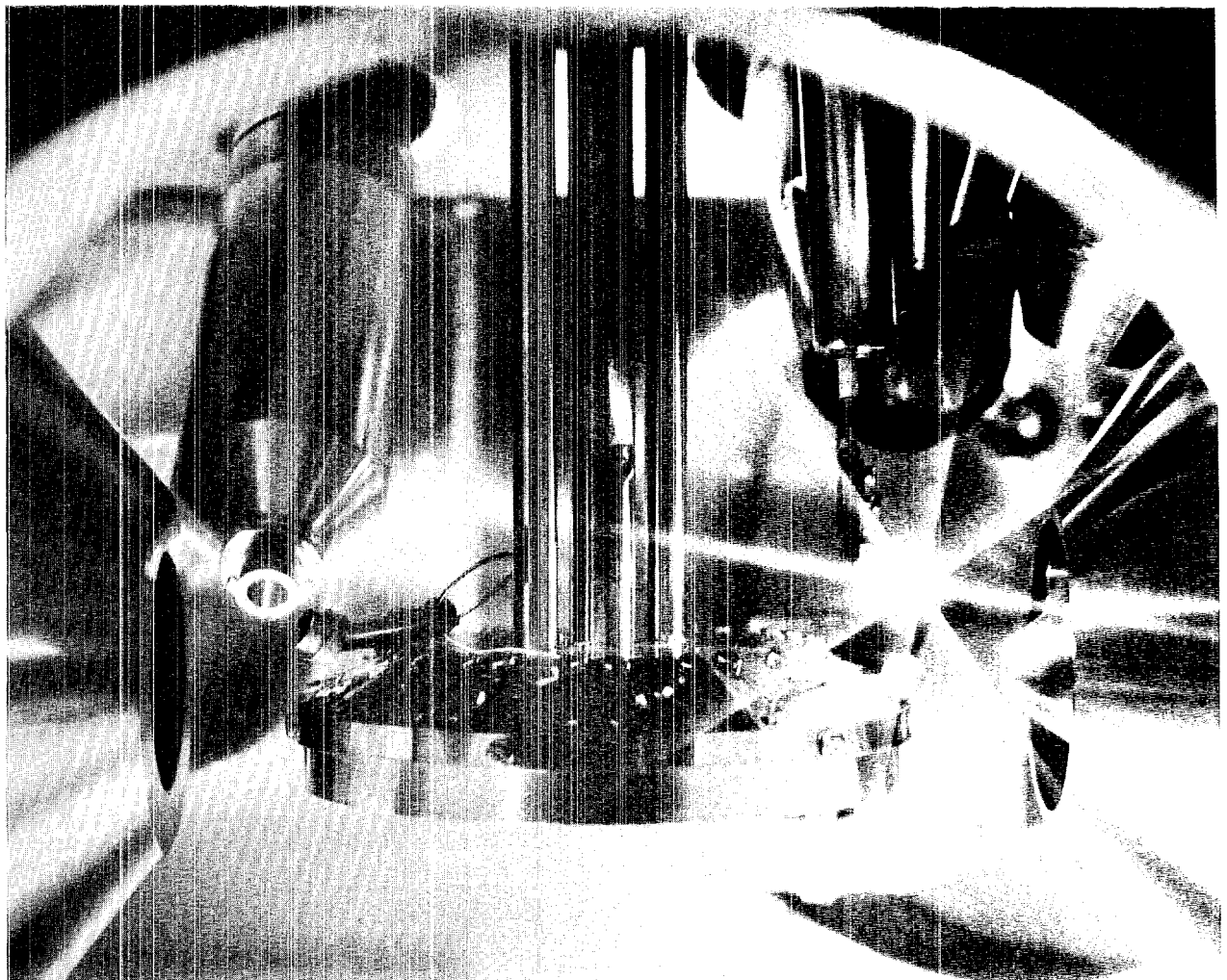
INVITATION TO VACATION TRAVEL

Los Alamos Scientific Laboratory employees can now affiliate with the 184 Club of the Lawrence Radiation Laboratory's Recreation Association. Group travel, at reduced cost, is available to Alaska, the Canadian Rockies, Hawaii, the eastern seaboard, the Orient, and the Holy Land. Rates range from \$299 to \$1,195. Arrangements will be coordinated by the LASL travel office.

NO DELAY FOR SCYLLAC

Even the heavy snows of March did not delay progress on the Laboratory and Energy Storage Facility for "Scyllac," an experiment in the controlled release of thermonuclear energy for peaceful purposes. Steel beams were erected despite 20.4 inches of snow falling in 12 days. The Scyllac building, costing \$2.2 million, should be completed in early 1970.

Culled from the April, 1969
files of *The Atom*



This photo of a scanning microprobe earned the Best of Show Award for Fred Rick, ISD-7 photographer, at the 28th annual conference of the Professional Photographers Association of New Mexico. There were over 400 entries, and about 150 of these were recognized for exhibition during the February 24-26 event. Robert Martin and Henry Ortega had three and six entries, respectively, exhibited; four others of Rick's were exhibited. The winning photograph, originally in color, was taken for Bob Springer of group CMB-6.

MOTZ HENRY THOMAS
3187 WOODLAND RD
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87544



Photo by Jeff Pederson

Trees blackened by the 1977 La Mesa forest fire cast long shadows on the winter snow in a scene near Pajarito Road.